Streptococcus pneumoniae Reporting, 2005

Causative Agent:

Streptococcus pneumoniae is the cause of several types of bacterial infections in humans. *S. pneumoniae* is a lancet-shaped, gram-positive, facultative anaerobic bacterium. Some pneumococci are encapsulated with complex polysaccharides, which are the basis of pathogenicity in humans. These encapsulations are the foundation for serotyping *S. pneumoniae*. The reservoir is presumed to be the nasopharynx of asymptomatic human carriers.

Clinical Features:

S. pneumoniae is a leading cause of pneumonia, meningitis, and bacteremia. Roughly half of cases are healthcare-associated and approximately one third of cases are community-associated. Additionally, *S. pneumoniae* is responsible for approximately 175,000 pneumonia hospitalizations per year. The symptoms of pneumococcal pneumonia typically include abrupt onset of fever, chills, and/or rigors. Other typical symptoms include pleuritic chest pain, productive cough, rusty sputum, dyspnea, tachypnea, hypoxia, tachycardia, malaise, and weakness. Bacteremia occurs in pnemococcal pneumonia patients nearly 30% of the time. The case-fatality rate for pneumonia is between five and seven percent, and possibly higher in elderly patients. The case-fatality rate for pneumococcal bacteremia is approximately 20%, although it can be as high as 60% in elderly patients. Pneumococci cause nearly 20% of the bacterial meningitis cases in the US. Twenty five percent of patients with pneumococcal meningitis also have pneumonia. Symptoms of bacterial meningitis may include headache, lethargy, vomiting, irritability, fever, nuchal rigidity, cranial nerve signs, seizures, and coma. The case-fatality rate for all pneumococcal meningitis is approximately 30%, and as high as 80% in elderly patients.

Drug resistance, especially to penicillin, is common. Forty percent of invasive isolates are also penicillin-resistant. Empiric treatment of *S. pneumoniae* usually includes a broad-spectrum cephalosporin and/or vancomycin until antibiotic susceptibility results are available.

Mode of Transmission:

The primary modes of transmission are respiratory droplets from person-to-person and autoinoculation in carriers. Household transmission can depend on crowding and presence of other disease. Furthermore, bacteria can remain viable in dust and in the air for long periods, although documented cases from this source are rare. Infection is more common in winter and early spring than during the rest of the year.

Incubation Period:

The incubation of pneumococcal pneumonia typically ranges from one to three days.

Period of Communicability:

The period of communicability is currently unknown. The popular presumption is that transmission can occur as long as organisms appear in respiratory secretions.

Prevention:

Currently, prevention measures include hand washing, respiratory hygiene, and vaccination. Respiratory hygiene includes covering one's mouth with a tissue or shirtsleeve while sneezing or coughing, and sometimes utilization of masks both for those that are infected and healthcare workers in close proximity. There are two types of vaccine, pneumococcal polysaccharide vaccine (PPV) and pneumococcal conjugate vaccine (PCV). PPV is 60-70% effective against invasive disease. PPV is the predominant vaccine for adults and is not licensed in children younger than 2 years old. PCV is >90% effective against invasive disease and is effective in infants. Neither vaccine is highly effective against pneumococcal pneumonia.

Findings of Case Reporting:

As of December 2004, all invasive cases of *S. pneumoniae* are reportable in Michigan through local health departments to MDCH. Each case is to be reported into the Michigan Disease Surveillance System (MDSS) under "Streptococcus pneumoniae, Inv". If the reported organism is also intermediate or resistant to one or more antimicrobials, then a paper copy of the MDCH *S. pneumoniae* Surveillance Case Report Form should also be completed and submitted with the specimen susceptibility results (See attachment).

It took some time to circulate the new reporting guidelines for invasive, *S. pneumoniae* and change occurred slowly. Therefore the 2005 cases reported into the MDSS and the 2005 cases reported on paper forms did not match, as they should. Due to

this discrepancy in reporting, the 2005 *S. pneumoniae* data was analyzed as two separate datasets, MDSS invasive *S. pneumoniae* data and paper case report form drug-resistant *S. pneumoniae* data. Current data collection for invasive, *S. pneumoniae* cases and the matching drug resistance information is expected to be reported into the MDSS and via the additional paper case report form as stated in the guideline (Appendix A). Therefore, cases from 2006 and beyond will be analyzed and reported as one dataset (invasive, *S. pneumoniae* with information on drug resistance).

From January 1, 2005 until December 31, 2005, 136 paper case report forms were submitted for *S. pneumoniae* cases. Sixty-two cases were classified as invasive and 74 were classified as non-invasive. The mean age from paper case report forms is 50.5 years with a range of one month to 91 years. Infection was nearly equal between men and women. A majority of the cases were white (68%). The data followed the common trend of having the highest percentage of occurrence in children, less than nine years old, and persons, greater than 70 years, comprising 21% and 32% of reported cases, respectively (Table 1 and Figure 1). During the same time period, 413 cases of invasive *S. pneumoniae* were entered into the MDSS. The MDSS cases displayed similar trends in both demographic and infection data as the paper case report forms (Tables 2-4).

Cases were reported from all regions of Michigan, both by paper case report forms and through MDSS (Figures 2 and 3). From the paper case report forms, 115 cases reported hospitalization. The average hospital stay was 6.1 days with a range from one to 31 days. Pneumonia and bacteremia were the most common types of infection, with 68 and 40 cases, respectively (Table 3). Fifteen patients reported both pneumonia and bacteremia. The most common underlying illnesses were emphysema/COPD and smoking (Table 5). The susceptibility results of all cases reporting this data displayed expected trends, as penicillins, macrolides, and folate pathway inhibitors demonstrated higher levels of resistance than other groups (Table 6). Furthermore, roughly two-thirds of cases were resistant to multiple classes of antimicrobials (67%), including 24% resistant to two classes and 43% resistant to three or more antimicrobial classes (Figure 4).

Because invasive, *S. pneumoniae* became reportable in December 2004, there is no data available prior to 2005 for comparison. However, we expect these results from 2005 data to provide a reliable comparison for future years of analysis.

Table 1. Demographic Characteristics of Patients with Drug-Resistant Pneumococcal Disease Reported from Paper Case Report Forms, 2005.

N=136	Number of Cases*	Percent of Total*
Sex		
Female	67	49%
Male	69	51%
Race		
African American	19	14%
American Indian/Alaskan Native	2	1%
Asian	1	1%
Caucasian	93	68%
Other	2	1%
Ethnicity		
Hispanic or Latino	0	0%
Age		
0-9 years	28	21%
10-19 years	2	1%
20-29 years	2	1%
30-39 years	5	4%
40-49 years	6	4%
50-59 years	12	9%
60-69 years	17	13%
≥70 years	44	32%

*totals for each demographic variable may not equal to total number of cases because of information missing from the case report form.

Figure 1. Age Group Comparison of Drug-Resistant Versus Invasive Pneumococcal Disease, 2005.

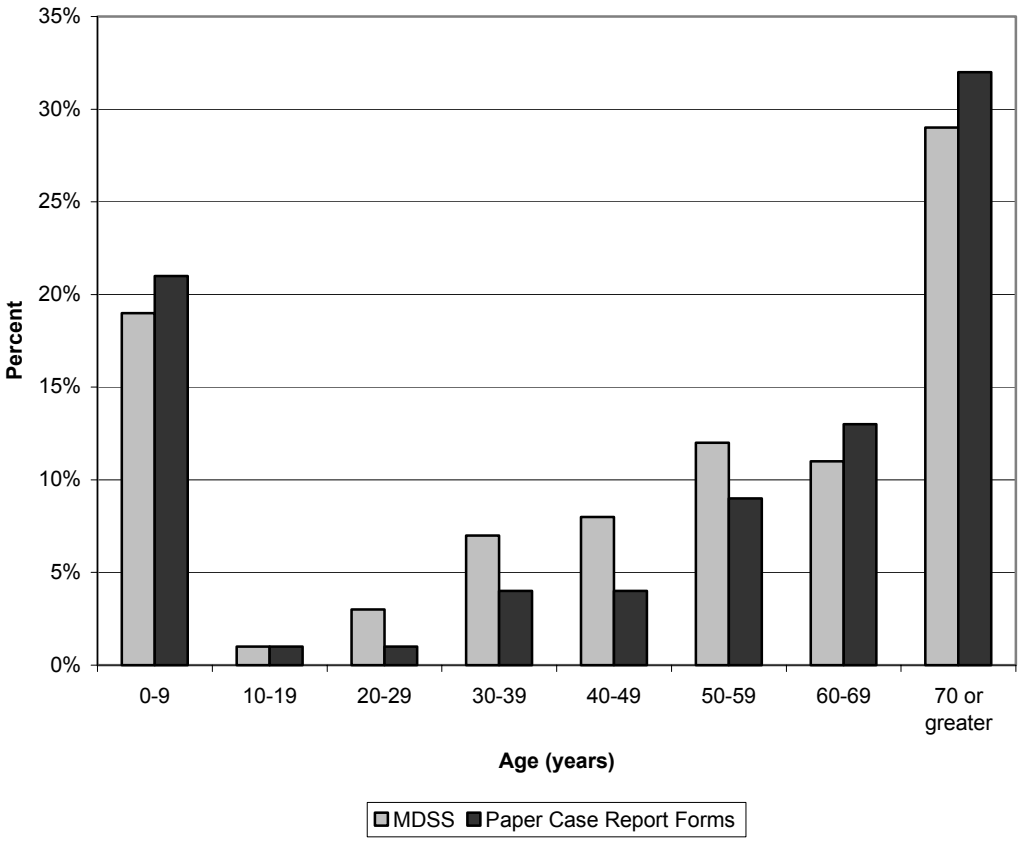


Table 2. Demographic Characteristics of Patients with Invasive Pneumococcal Disease Reported in MDSS, 2005

N=413	Number of Cases*	Percent of Total*
Sex		
Male	203	49%
Female	210	51%
Race		
African American	77	19%
Asian	6	1%
Caucasian	248	60%
Other	9	2%
Ethnicity		
Hispanic or Latino	9	2%
Age		
0-9 years	77	19%
10-19 years	4	1%
20-29 years	13	3%
30-39 years	27	7%
40-49 years	34	8%
50-59 years	49	12%
60-69 years	44	11%
≥70 years	121	29%

*totals for each demographic variable may not equal to total number of cases because of information missing from the case report form.

Figure 2. Incidence of Drug-Resistant Pneumococcal Disease, by County, Reported from Paper Case Report Forms, 2005.

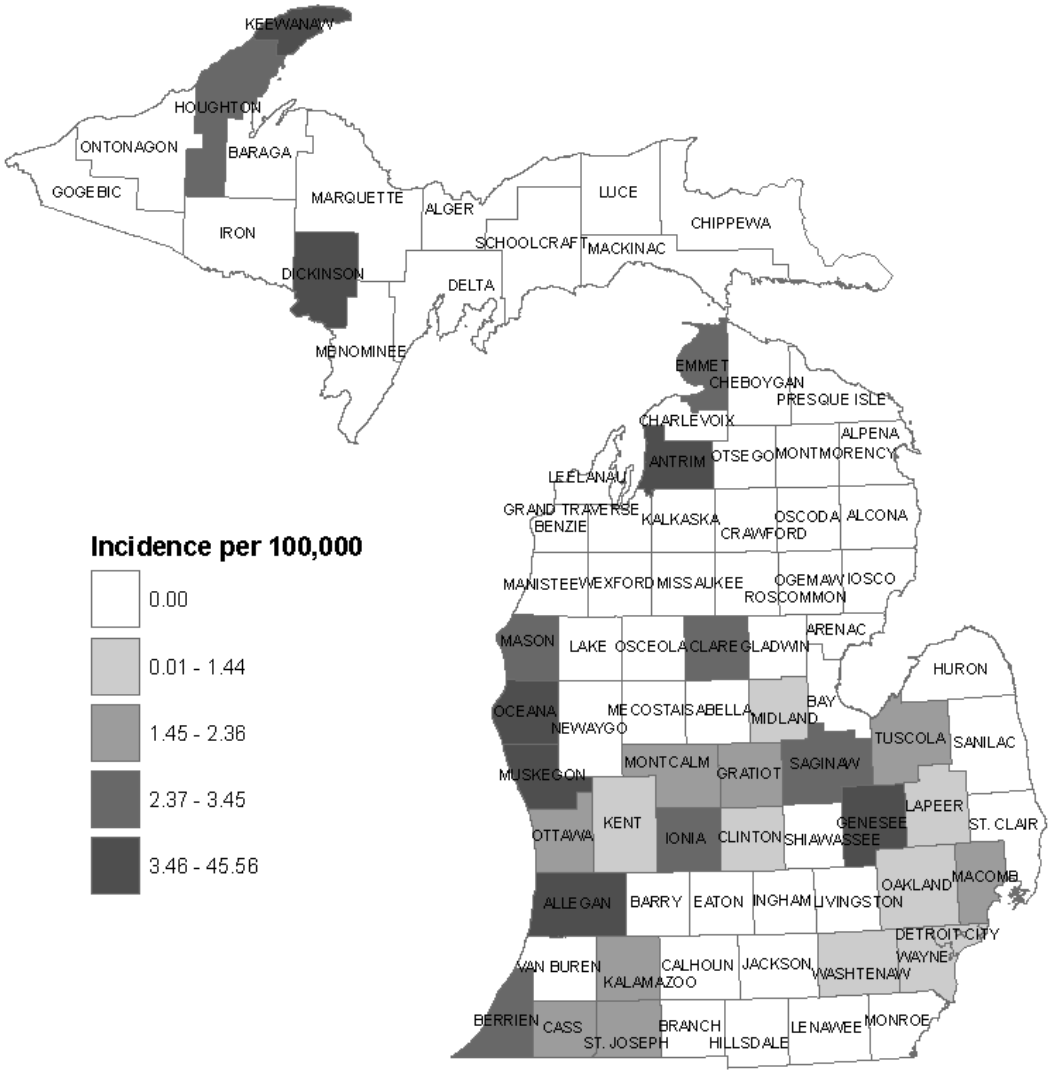


Figure 3. Incidence of Invasive Pnemococcal Disease, by County, Reported in MDSS, 2005.

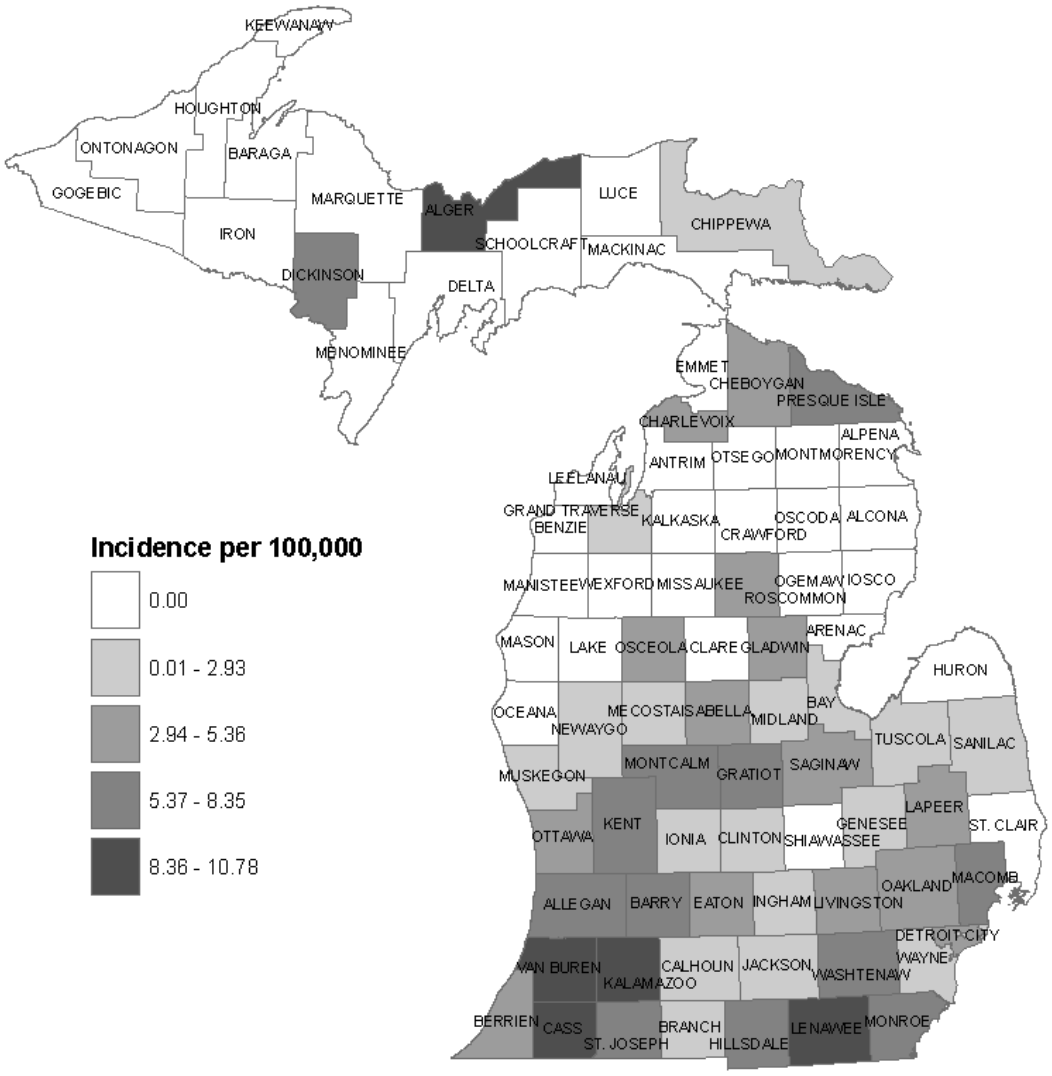


Table 3. Infection Types from Paper Case Report Forms. 2005:

Infection Type (n=127*)	Yes (%)	No (%)
Pneumonia	68 (54)	59 (46)
Bacteremia	40 (31)	87 (69)
Otitis Media	10 (8)	117 (92)
Sinusitis	6 (5)	121 (95)
Cellulitis	1 (1)	126 (99)
Meningitis	1 (1)	126 (99)

*total number for each infection type does not equal total number of paper case reports (n=136) because of information missing from the case report form.

Table 4. Infection Types from MDSS Detail Report Forms. 2005:

Infection Type (n=411*)	Yes (%)	No (%)
Bacteremia	229 (56)	182 (44)
Pneumonia	186 (45)	225 (55)
Meningitis	19 (5)	392 (95)
Otitis Media	7 (2)	404 (98)
Cellulitis	4 (1)	407 (99)
Sinusitis	2 (<1)	409 (99)

*total number for each infection type does not equal total number of MDSS reports (n=413) because of information missing from the detail report form.

Table 5. Underlying Illnesses from Paper Case Report Forms. 2005:

Underlying Illness (n=78*)	Yes (%)	No (%)
Emphysema/COPD	30 (38)	48 (62)
Smoker	25 (32)	53 (68)
Other Illness	18 (23)	60 (77)
Other Malignancy	15 (19)	63 (81)
Cardiovascular Disease	13 (17)	65 (83)
Diabetes Mellitus	12 (15)	66 (85)
Asthma	9 (12)	69 (88)
Heart Failure/CHF	9 (12)	69 (88)
Renal Failure/Dialysis	6 (8)	72 (92)
Immunosuppresive Therapy	5 (6)	73 (94)
Alcohol Abuse	5 (6)	73 (94)
Multiple Myeloma	2 (3)	76 (97)
Leukemia	2 (3)	76 (97)
HIV Infection	2 (3)	76 (97)
Sickle Cell Anemia	1 (1)	77 (99)
Immunoglobulin Deficiency	1 (1)	77 (99)
Cirrhosis/Liver Failure	1 (1)	77 (99)

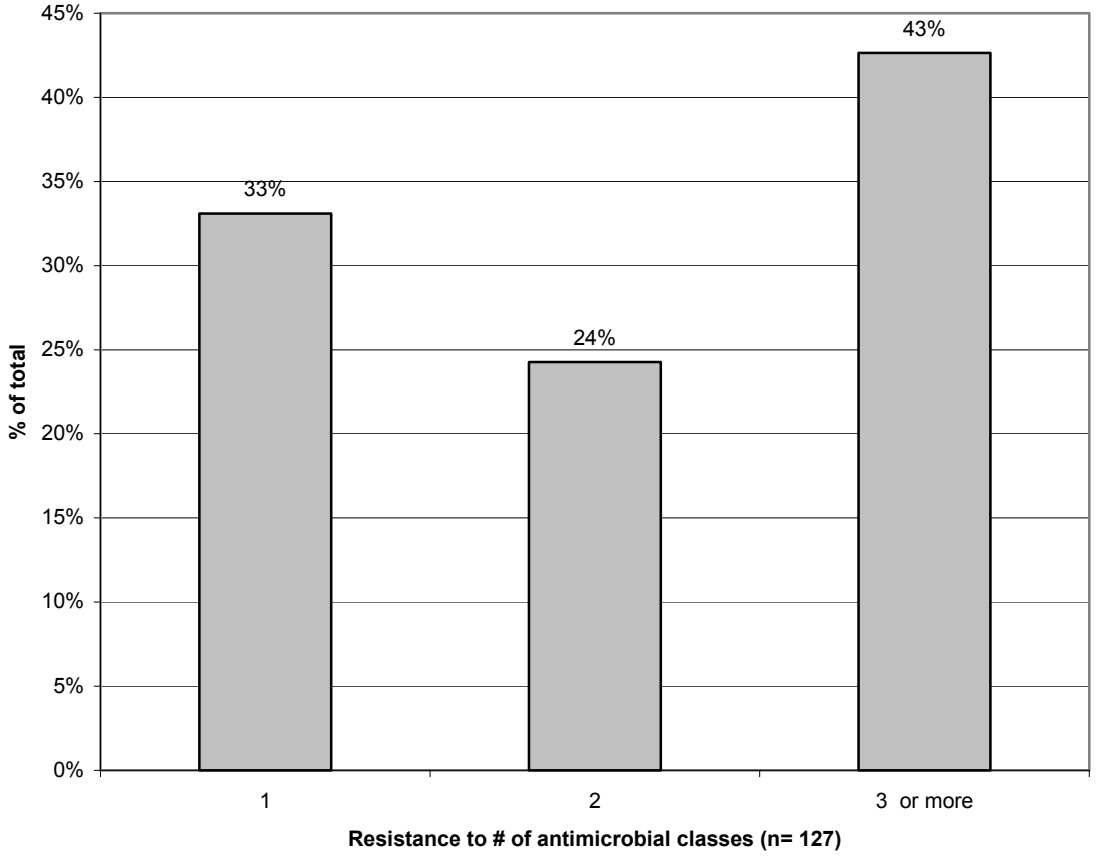
*total number for each underlying illness does not equal total number of paper case reports (n=136) because of information missing from the case report form.

Table 6. Frequency of Antimicrobial Class Susceptibility Reported from Paper Case Report Forms, 2005:

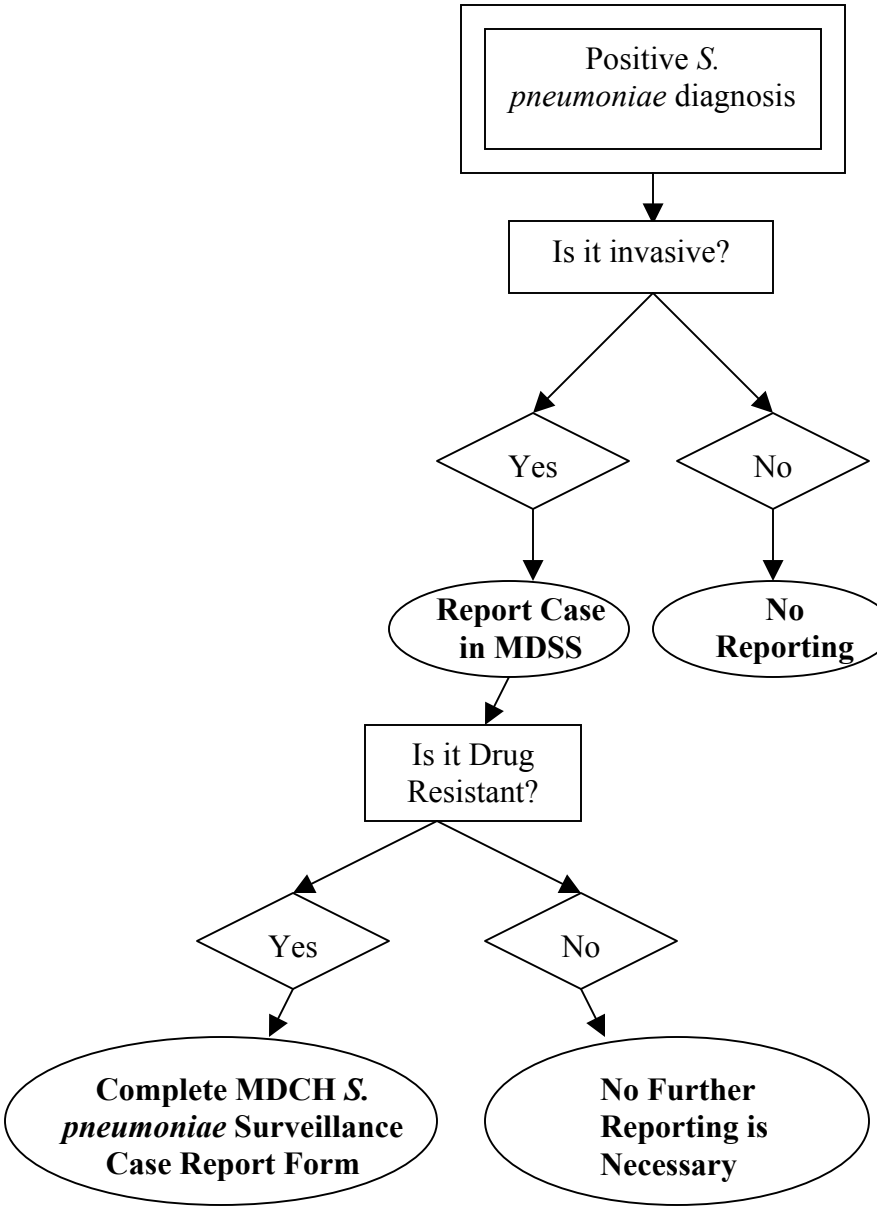
Antimicrobial Class (n=127)	Antimicrobial	S (%)*	I (%)*	R (%)*
Penicillin	Penicillin	12 (9)	66 (49)	52 (38)
	Amoxicillin			
	Oxacillin			
β-Lactams/β-Lactamase inhibitor combinations	Amoxicillin-Clavulanic Acid	2 (2)	0 (0)	0 (0)
Cephems (parenteral)	Cefotaxime	51 (38)	14 (10)	11 (8)
	Ceftraxone	62 (46)	15 (11)	11 (8)
	Cefuroxime	19 (14)	4 (3)	27 (20)
	Cefepime	12 (12)	2 (1)	2 (1)
Cephems (oral)	Cefaclor	1 (1)	2 (1)	6(4)
Carbapenems	Imipenem	3 (2)	2 (1)	0 (0)
	Meropenem	13 (10	4 (3)	8 (6)
Ansamysins	Rifampin	9 (7)	0 (0)	0 (0)
Quinolones	Gatifloxacin	21 (15)	1 (1)	0 (0)
	Levofloxacin	65 (48)	1 (1)	2 (1)
	Moxifloxacin	14 (10)	0 (0)	0 (0)
	Ofloxacin	4 (3)	0 (0)	0 (0)
Folate Pathway Inhibitors	Trimethoprim-Sulfamethoxazole	15 (11)	8 (6)	46 (34)
Lincosamides	Clindamycin	8 (6)	1 (1)	8 (6)
Macrolides	Azithromycin	5 (4)	0 (0)	10 (7)
	Clarithromycin	1 (1)	0 (0)	0 (0)
	Erythromycin	26 (19)	5 (4)	77 (57)
Oxaxolidinones	Linezolid	4 (3)	0 (0)	0 (0)
Glycopeptides	Vancomycin	78 (57)	0 (0)	0 (0)
Phenicols	Chloramphenicol	37 (27)	0 (0)	0 (0)
Tetracyclines	Tetracycline	30 (22)	1 (1)	23 (17)
	Doxycycline	3 (2)	1 (1)	2 (1)

*totals for each classification (S/I/R) variable may not equal to total number of cases because of information missing/unknown from the submitted susceptibility test results.

Figure 4. Percentage of *S. pneumoniae* Resistant to Multiple Classes of Antimicrobials, Reported from Paper Case Report Forms, 2005.



Appendix A. MDCH Reporting Diagram Guides for *S. pneumoniae*



	Non-Invasive	**Invasive**
Not Drug-Resistant	No Reporting Required	Reportable in MDSS
Drug-Resistant	No Reporting Required	Reportable in MDSS and MDCH *S. pneumoniae* Surveillance Paper Case Report Form

References:

Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Atkinson W, Hamborsky J, McIntyre L, Wolfe S, eds. 9th ed. pp. 255-267. Washington DC: Public Health Foundation, 2006. Available at http://www.cdc.gov/nip/publications/pink/.

Manual of Clinical Microbiology. Murray P, Barron E, Jorgensen J, Pfaller M, Yolken R, eds. 8th ed. pp. 405-408. Washington DC: ASM Press, 2003.